Arizona (2)

Project Information	
High Value Research Title	Communication Plan for Windblown Dust
Project Number	SPR-723
Project Cost	$125,000
Project Duration	16 months
Web link	http://apps.azdot.gov/ADOTLibrary/publications/project_reports/pdf/az723.pdf
Submitter	
Submitter Agency	Arizona Department of Transportation
Submitter (Name, Address, Phone, Email)	Dianne Kresich Arizona Department of Transportation Research Center 206 S. 17th Avenue, MD 075R Phoenix, AZ 85007 602-712-3134 dkresich@azdot.gov
Research Program	
Sponsoring Agency Name	Arizona Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	Dianne Kresich Arizona Department of Transportation Research Center 206 S. 17th Avenue, MD 075R Phoenix, AZ 85007 602-712-3134 dkresich@azdot.gov
Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	Windblown dust events occur along Interstate 10 between Phoenix and Tucson, and have been considered a contributing factor in serious crashes in that region. The Arizona Department of Transportation (ADOT) Research Center conducted a study to learn the most effective means to acquire data about approaching or in-progress dust events, and to communicate information about approaching and in-progress dust storms to the public using a variety of means, such as social media, traditional media, and Intelligent Transportation System technologies. WHAT WE DID: The research team: (a.) Evaluated the meteorological conditions that lead to windblown dust on

Arizona highways
(b.) Identified practices that ADOT and other state transportation agencies use to acquire and communicate information about conditions of reduced visibility
(c.) Collected perspectives from Arizona travelers on ADOT's current dust-related communication methods and travelers' need for such information through a survey and focus groups

WHAT WE LEARNED:

The research provided ADOT with an evidence-based understanding of driver behavior during dust storms, driver perceptions of the department's dust-related messaging, and preferred channels of communication about dust.

Findings led to the development of recommendations relevant to the I-10 corridor that include: installation of additional dynamic message signs; communication through more diverse channels to reach drivers of all ages; refinement of the "Pull Aside, Stay Alive" campaign, particularly by adding the rationale behind specific driving tips; distribution of dust-related materials at rest stops, truck stops, and visitor centers to reach out-of-state drivers who are not familiar with dust event; and further research on to evaluate a dust detection and communication system (now under way).

HOW IT'S MAKING A DIFFERENCE:

The findings and recommendations are considered a communication plan that is helping ADOT Communications staff convey important information to the public, including the media and commercial and noncommercial drivers. The plan details tools, process steps, and the desired outcomes of the communication outreach.

In a direct response to study's qualitative and quantitative findings and recommendations, ADOT produced a new dust-oriented public service announcement (PSA) and purchased television air time to distribute the message throughout Arizona. In contrast to past PSAs that focused on the "Pull Aside, Stay Alive" slogan, the new announcement depicts a driver demonstrating the steps to take during a dust event. The PSA, titled "Where Will You Be When the Dust Settles?," is posted at https://www.youtube.com/watch?v=pkBOtAn83oQ.

Also in response to study recommendations, ADOT conducted a short-term campaign to inform commercial drivers of tips for driving during dusty weather conditions through the distribution of informational cards.

The research has drawn the attention of a diverse range of stakeholders. The research project manager and communication director presented findings and ongoing implementation at the 2015 Arizona Conference on Roads and Streets, an annual event that attracts nearly 1500 transportation professionals. They also presented at the 2014 and 2015 Dust Storm Workshops, which were

	sponsored by ADOT and the National Weather Service, and attended by elected officials, the media, and experts in traffic safety, climatology, air quality, and public health. A poster representing the project was accepted for display at the 2016 Transportation Research Board Annual Meeting. Further research recommended by this project is now under way. ADOT's goal is to inform drivers about windblown dust hazards in real-time so that they can make decisions to enhance their safety. The current research is exploring dust detection and communication technologies to determine if any might help the department to achieve this goal and be feasible for field testing.

Project Information

High Value Research Title	Detection and Warning System for Wrong-Way Driving
Project Number	SPR-741
Project Cost	$100,000
Project Duration	10 months
Web link	http://apps.azdot.gov/ADOTLibrary/publications/project_reports/PDF/az741.pdf

Submitter

Submitter Agency	Arizona Department of Transportation
Submitter (Name, Address, Phone, Email)	Jean Nehme, Ph.D., P.E. 206 S. 17th Ave., MD 075R Phoenix, AZ 85007 602.712.4515 jnehme@azdot.gov

Research Program

Sponsoring Agency Name	Arizona Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	Jean Nehme, Ph.D., P.E. 206 S. 17th Ave., MD 075R Phoenix, AZ 85007 602.712.4515 jnehme@azdot.gov

Research and Results

Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	BACKGROUND From 2004 through 2014, 245 wrong-way crashes occurred in Arizona, resulting in 91 fatalities. Following a spike in wrong-way crashes that resulted in multiple fatalities in mid-2015, the Arizona Department of Transportation (ADOT) director initiated various efforts to address wrong-way driving. One of these efforts was to conduct a short-term research study to develop a plan for a pilot

	deployment of wrong-way countermeasures. APPROACH The research included an extensive literature search and analysis of Arizona and national statistics on wrong-way driving to better understand wrong-way crashes. In addition, the study explored state-of-the-art systems of detecting, notifying, and tracking a wrong-way driver; and of providing timely warnings to the wrong-way driver, relevant authorities, and other motorists. The research then assessed the viability of these systems for use in Arizona, and developed a comprehensive pilot deployment and monitoring plan for ADOT consideration. FINDINGS AND RECOMMENDATIONS This research developed an innovative conceptual system to detect a wrong-way driver upon entry, inform the errant driver of the mistake, notify the ADOT Traffic Operations Center and law enforcement instantly, track the wrong-way vehicle on the highway system, and warn right-way drivers in the vicinity of the oncoming vehicle. The proposed design integrates readily available technologies with ADOT's existing freeway management system infrastructure. Currently, ADOT is working with its vendors to test the feasibility of using existing loop detectors and controllers to detect wrong-way drivers. Two locations in the Phoenix metropolitan area are being tested. ANTICIPATED BENEFITS The pilot deployment is expected to determine whether the recommended wrong-way detection, notification, and warning system on Arizona highways results in a more rapid response to wrong-way driving, and a reduction in crashes, fatalities, and injuries involving wrong-way and right-way drivers. Larger-scale implementation may follow the assessment of the deployed technology at the two test locations.

California (5)

Project Information	
High Value Research Title	Compliance Crash Testing of the Type 732SW Bridge Rail
Project Number	P703
Project Cost	$0
Project Duration	30 months
Web link	Link
Submitter	
Submitter Agency	California Department of Transportation
Submitter (Name, Address,	David Whitesel 5900 Folsom Blvd., MS-5 Sacramento, CA 95819 (916)

Phone, Email)	227-5849 david_whitesel@dot.ca.gov
Research Program	
Sponsoring Agency Name	California Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	5900 Folsom Blvd, Sacramento, CA 95833
Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	The outcome of this research is a standard plan for a MASH-compliant bridge rail that includes a pedestrian and bicycle friendly sidewalk. This will improve Caltrans' goal of providing Complete Street design aspects that are ADA, pedestrian, and bike friendly. Caltrans plans to use this design throughout California.

Project Information

High Value Research Title	Research & Development of Open-Source Advanced Traffic Management
Project Number	P338
Project Cost	$0
Project Duration	116 months
Web link	http://www.dot.ca.gov/research/researchreports/reports/2014/final_report_task_2293.pdf
Submitter	
Submitter Agency	California Department of Transportation
Submitter (Name, Address, Phone, Email)	Melissa Clark 1227 O Street Sacramento, CA 95814 (916) 657-4448 melissa.clark@dot.ca.gov
Research Program	
Sponsoring Agency Name	California Department of Transportation
Sponsoring	1227 O Street, Sacramento, CA 95814

Agency Contact (Name, Address, Phone, Email)	

Research and Results

Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	Rural areas need a unified ATMS that is designed for their traffic requirements and environment. IRIS offers rural districts a robust, unified, traffic management program that is extensible, scalable, and reliable. Traffic management operators can centrally manage traffic devices and applications from a single, integrated interface at a fraction of the cost of a full ATMS software running in urban areas. The open-source software enables collaboration among government agencies, universities, and private companies. Reduces life cycle costs by approximately 72% versus the existing ATMS. Deployment of IRIS to Caltrans Districts 1, 2, 5, and 10 was successful. The number of traffic management software applications and servers in the four districts has been reduced, with IRIS assuming the roles. The improved and simplified build and deploy process facilitates adoption and makes it easier to train new developers. Through knowledge transfer from the research team, supporting IRIS has transitioned to a third-party contractor. Caltrans District 3 is expected to be the next district to implement part of the IRIS system.

Project Information

High Value Research Title	Travel Time Detector Installation and Integration
Project Number	P979
Project Cost	$0
Project Duration	0 months
Web link	

Submitter

Submitter Agency	California Department of Transportation
Submitter (Name, Address, Phone, Email)	John Slonaker 1227 O Street Sacramento, CA 95814 (916) 657-4063 john.slonaker@dot.ca.gov

Research Program

Sponsoring Agency Name	California Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	1227 O Street, Sacramento, CA 95814

Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	The City of South Lake Tahoe asked Caltrans to post estimated travel times on its changeable message signs on US 50 to let travelers know how long it would take them to get back to the Sacramento area. However, there was no existing infrastructure to measure travel times along this route. One of Caltrans' strategic goals is to improve travel time reliability and reduce peak-period travel times and delays, so Caltrans wanted to fulfill the request. The solution was to use Bluetooth readers, which detect Bluetooth signals from travelers' mobile devices as they travel along a highway. By capturing these signals, and keeping track of them as the associated vehicle travels from the first field unit to other field units miles down the road, the travel time for that vehicle can be measured. This data is then averaged with the similar travel time measurements provided by other vehicles to result in a timely, accurate, and reliable travel time for the route. Caltrans then posts this information on its changeable message signs and on QuickMap, the Caltrans mobile app that provides motorists with real-time travel conditions. Bluetooth readers were installed at multiple locations along US 50, and software was created to push the information out to QuickMap and the changeable message signs. The system has been operating since the Fourth of July weekend in 2015. The success of this project indicates that it may be a solution in areas of the state where travel time data is currently not available, but would be beneficial to the traveling public and as a way to stimulate local economies. Total cost for the US 50 project was about $150,000, including labor and materials.

Project Information

High Value Research Title	Mobile Terrestrial Laser Scanning Workflow Development, Technical Support and Evaluation
Project Number	P625 (Task Number 2517)
Project Cost	$0
Project Duration	20 months
Web link	http://www.dot.ca.gov/research/researchreports/reports/2014/CA14-2517_FinalReport.pdf

Submitter	
Submitter Agency	California Department of Transportation
Submitter (Name, Address, Phone, Email)	Arvern Lofton 1227 O Street Sacramento, CA 95814 (916) 657-4062 alofton@dot.ca.gov

Research Program	
Sponsoring Agency Name	California Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	1227 O Street, Sacramento, CA 95814

Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	Caltrans requires survey grade measurements for various projects such as bridge and pavement construction, major accident investigations, roadside assets management, and more. Performing a survey typically exposes field personnel to high-speed traffic, often without any barrier or protection. Mobile Terrestrial Laser Scanning (MTLS), a relatively new technology, enables surveyors to work safely from inside a vehicle. An MTLS system produces accurate and precise geospatial data at or near highway speeds, enabling surveyors to collect many miles of roadway point-cloud data in a single day, thus accelerating project delivery. Users in the office can then work with the broad range of data collected, removing the need for surveyors to return to the field for measurements. For these reasons, Caltrans purchased an MTLS system in 2012. As a result of the research, Caltrans surveyors successfully utilized the MTLS system throughout northern California on over 90 projects. In addition, the research findings led to a new MTLS research effort, which proposes to extend training, technical support, and integration of MTLS into Caltrans workflow throughout central and southern California.

Project Information

High Value Research Title	Bay Area Airport Disaster Recovery Plan
Project Number	P566
Project Cost	$0
Project Duration	23 months
Web link	http://resilience.abag.ca.gov/wp-content/documents/Cascading_Failures/Role-of-Airports-in-Disasters_2015.pdf

Submitter	
Submitter Agency	California Department of Transportation
Submitter (Name, Address, Phone, Email)	Patrick Tyner 1227 O street Sacramento, Ca 95814 (916) 657-3964 patrick.tyner@dot.ca.gov

Research Program	
Sponsoring Agency Name	California Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	1227 O Street, Sacramento, Ca 95814
Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	The Bay Area Airport Disaster Recovery Plan focuses on identifying the vulnerabilities, and interdependencies airports have relative to lifeline systems (transportation, power, water, gas, etc.), as a way to understand how to better to exploit the opportunities that Bay Area airports could provide to the recovery.

New Mexico (2)

Project Information	
High Value Research Title	Optimization of Elastic Polymer Modification Rates Based on Contemporary Relative Costs vs. Benefits.
Project Number	NM14-MSC-01-008
Project Cost	$15,000
Project Duration	22 months
Web link	http://dot.state.nm.us/content/dam/nmdot/Research/NM14MSC-01_PlusGradeBinder_final%20report.pdf
Submitter	
Submitter Agency	New Mexico Department of Transportation
Submitter (Name, Address, Phone, Email)	Stephen J. Hemphill, P.E.; P.O. Box 94690; Albuquerque, NM 87199; 505-798-6734; stephen.hemphill@state.nm.us
Research Program	
Sponsoring Agency Name	New Mexico Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	James Gallegos, P.E.; NMDOT Materials Engineer; Materials Lab; 1120 Cerrillos Rd; Santa Fe, NM 87504
Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact,	SBS use has become commonplace, however this project concentrated on quantifying the benefit of going to an elastomeric vs. plastomeric modifier as well as determining the direction of future studies.

of Implementing Research Results	Additional initial up-front (construction costs) were estimated to be less than 5%, with actual quotes from contractors to change from a PG70-28 to a PG70-28+ averaging less than $2 per ton for H/WMA or from 3% to 4%. Life extension has been estimated to be over 20%. Currently New Mexico spends about $100 million per year on H/WMA with a typical lifetime of 10 years (mostly mill and fill). Using these estimates and a discount rate of 3%, adding two years to the life of the roadways will cost approximately $3.5 million per year and will, when current roadway surfaces are replaced, save approximately $8 million per year. Further, during Phase 2 levels of polymer addition will be analyzed with MSCR, mechanistic analyses, and other tests to be determined to further optimize the economics of quantifying the level of polymer, especially since the relative cost of asphalt vs. e.g. SBS have changed dramatically. LTPP PG grading recommendations (LTPPBind) were determined when asphalt binder was approximately $100 per ton (1990's), and e.g. SBS was ~$2,000 per ton. In 2007 and 2008, the price of crude skyrocketed, leading briefly to a 7 or 8 fold increase in the cost of asphalt. This tipped the economics for refineries in favor of installing crackers, to maximize the higher profit lighter distillates. This also increased the availability of products for SBS production. Although the price of asphalt has since dropped in half from the peak of 2008, it's still 3 or 4 times what it was when LTPPBind was published, and SBS is still ~$2,000 per ton. Although it is easy to look up a dogmatic level of PG grading for a certain location based on temperature and traffic, the fact is an engineering solution like this considers the costs and benefits of additional polymerization, as the suitability of a specific PG grade does not just drop off precipitously, but is the superposition of the two curves. As the cost of improving the product drops with reference to the increasing benefit, life cycle analysis will show an increase of polymerization is in order to maximize relative benefit. Therefore, the subsequent phase of this project will analyze that information, along with the increased knowledge of elastic polymer modification gleaned over the last 20 years, in order to optimize the level of modification.

Project Information

High Value Research Title	River Restoration Through Application of Fluvial Geomorphological Theory vs. Reactive Repairs
Project Number	NM14ENV-01
Project Cost	$59,899
Project Duration	8 months
Web link	

Submitter	
Submitter Agency	New Mexico Department of Transportation
Submitter (Name, Address, Phone, Email)	Amy Estelle, PhD NMDOT Research Bureau 7500B Pan American Freeway P.O. Box 94690 Albuquerque, NM 87199

Research Program
No data entered for this section

Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	Because the NMDOT has extremely limited right-of-way in which to work, it is not often in the business of ecological restoration. The condition of the channel under NMDOT structures, whether it is causing sedimentation or erosion, is nearly entirely the result of upstream watershed management. However, as climate change-driven droughts, fires, and floods are expected to become more frequent, an increased burden has been placed on the NMDOT to continue to deliver the same level of quality and safety without an increase in funding or manpower. The fundamental idea behind this project is that an expanded scope of work venturing beyond the right-of-way, coupled with a professionally-designed and implemented restoration plan, can achieve a healthy river system that has room to flood, will not damage transportation infrastructure and thus increase its lifespan, and require nearly zero amount of maintenance. It has become increasingly apparent that healthy streams will less frequently destroy roadways and that healthy rangelands do not cause zero visibility dust storms. These dangerous events are the result of ecosystems that are out of balance and are nearly impossible to manage consistently. If the NMDOT is looking at long-term solutions to some of its most pressing problems, perhaps it is indeed in the business of restoration.

Oklahoma (1)

Project Information	
High Value Research Title	Creep Compliance and Percent Recovery of Oklahoma Certified Binders Using the Multiple Stress Creep Recovery (MSCR) Method
Project Number	SP&R 2248SPRY-0010(56)RS
Project Cost	$210,295
Project Duration	26 months
Web link	http://l92018.eos-intl.net/L92018/OPAC/Index.aspx

Submitter	
Submitter Agency	Oklahoma Department of Transportation
Submitter (Name, Address, Phone, Email)	Gary Hook ODOT 200 NE21 Oklahoma City, Oklahoma 73105 405-522-1042
Research Program	
Sponsoring Agency Name	Oklahoma Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	200 NE 21st Street Oklahoma City OK USA 73105
Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	In recent years, the use of polymer-modified binders in the United States has grown tremendously. Nationally, asphalt industries use more than 22 million tons of neat binders and over 7.5 million tons (about 25% of the total use) of polymer-modified (e.g., styrene-butadiene-styrene (SBS), styrene-butadiene-rubber (SBR)) binders in producing about 600 million tons of asphalt concrete (AC) mixes annually. Oklahoma consumes about 200,000 tons of asphalt binders, of which about 50,000 tons are polymer-modified, in producing about 4 million tons of asphalt mixes. In addition, Oklahoma Turnpike Authority (OTA) consumes about 100,000 tons of asphalt binders annually in producing about 2 million tons of AC mixes. The AASHTO T 315 method (AASHTO, 2008), based on a study of neat (unmodified) binders, is being used by the asphalt industry to characterize polymer-modified binders, which may not properly characterize polymer-modified binders (Horan, 2011). Likewise, the usage of reclaimed asphalt pavement (RAP) in preparing new mixes has increased in recent years due to a national movement toward using the "green paving" technology. Thus, the characterization of recovered binder from RAP is required to attain proper blending with virgin binder. Such characterization of the recovered binder at high temperature is currently being performed in accordance with the AASHTO T 315 method even though this method cannot detect the presence of polymer, if any, in the recovered binder. Validated the AASHTO standard and changed the state specification for testing.

South Dakota (1)

Project Information

High Value Research Title	Agricultural Freight Data Improvement
Project Number	SD2014-09

Project Cost	$150,000
Project Duration	13 months
Web link	
Submitter	
Submitter Agency	South Dakota Department of Transportation
Submitter (Name, Address, Phone, Email)	David L. Huft South Dakota Department of Transportation, Office of Research 700 East Broadway Avenue Pierre, SD 57501-2586 605.773.3358 dave.huft@state.sd.us
Research Program	
Sponsoring Agency Name	South Dakota Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	
Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	This research was performed as a proof-of-concept project under the SHRP2 Implementation Assistance Program to explore innovative sources and applications of freight data related to agricultural production and transportation. The research investigated non-traditional sources of data related to current and future productivity, acreage, proximity to transportation facilities, and transportation network condition. Further, the research successfully demonstrated the integration and application of these sources in several previously impossible applications in a 5-county region in central South Dakota. The research also produced a versatile computational tool that can be configured for other analysis areas and additional types of analysis related to both public and private investment decisions. The work will enable South Dakota DOT and local agencies to analyze current and future transportation demands and system performance. Likewise, the agriculture, trucking, and rail industries can use the tool to analyze facility siting decisions. Although the research and demonstration analyses were performed for South Dakota's agricultural and transportation environment, the methods are fully transferable to any US location and agricultural environment. The study final report is attached.

Texas (8)

Project Information

High Value Research Title	Evaluation of Design and Construction Issues of Thin HMA Overlays
Project Number	0-6742
Project Cost	$311,900
Project Duration	23 months
Web link	http://tti.tamu.edu/documents/0-6742-1.pdf

Submitter

Submitter Agency	Texas Department of Transportation
Submitter (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov

Research Program

Sponsoring Agency Name	Texas Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov

Research and Results

Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	While the overall implementation of thin HMA overlays in Texas has been successful, some issues needed to be addressed: appropriate blending of SAC A and SAC B aggregate to ensure adequate skid resistance; best practices to achieve adequate bonding (surface prep and tack coats); and correct quality assurance test methods to achieve adequate compaction. This research addressed these concerns through laboratory and field testing. In addition, preliminary work to refine a crack propagation model for thin overlays was performed. Laboratory friction testing considered samples with two gradation types, four aggregates types, and five levels of aggregate blending. Samples were polished with simulated traffic in the lab and tested with a dynamic friction tester. Results show the terminal polish value for all designs with 100 percent SAC B replacement failed, as had designs with 50 and 75 percent blending of one SAC B+ and one marginal SAC B aggregate. SAC B replacement up to 25 percent was acceptable for all aggregates. Shear and tensile strength tests were developed to measure interlayer bond strength. A computer model suggested the maximum shear stress at a bonded thin-overlay interface is 120 psi. Bond strength tests were performed on laboratory samples made with two base mix types, two thin overlay types, 5 tack types (including non-tracking tacks), 3 tack rates, simulated milling, and moisture conditioning. Bond strength was most dependent on the mix type being bonded and compaction effort,

	and less on tack type and tack rate. In the tensile strength tests and half the shear tests, non-tracking tacks had higher strengths than samples using CSS-1H or no tack. No single non-tracking tack was found to have better performance than others. Variable tack rates of CSS-1H were only significant on dense-graded mixes. Low and moderate levels of tack provided the best bond. Milled samples had higher strength than unmilled samples in shear. A tack tracking test was developed to discern different non-tracking times during curing. Four compaction quality assurance test methods were used on three thin overlay projects. Properties measured were flow time with the current TxDOT permeability test, surface dielectric with high-frequency ground penetrating radar, mean profile depth (MPD) with the circular-track meter, and bulk density from field cores. Correlations of the tests were strong on a project-by-project basis, but generally not good when combining the data sets. Flow Time-MPD, Flow Time-Core Voids, and Surface Dielectric-Core Voids were best correlations overall. The researchers provided support to TxDOT on many new thin overlay demonstration projects, ranging from mix design, performance testing, construction method recommendations, and bonding testing. Using tack did not influence bond strength except for one fine-permeable friction course in shear testing. Thermal segregation problems were noted on two projects. The researchers developed draft specifications, including aggregate blending guidelines, bond strength testing, micromilling, and minimum and maximum flow times for compaction quality control.

Project Information

High Value Research Title	Accounting for Electric Vehicles in Air Quality Conformity
Project Number	0-6763
Project Cost	$365,061
Project Duration	23 months
Web link	http://tti.tamu.edu/documents/0-6763-1.pdf
Submitter	
Submitter Agency	Texas Department of Transportation
Submitter (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov
Research Program	
Sponsoring Agency Name	Texas Department of Transportation
Sponsoring Agency Contact	Wade Odell, P.E., Texas Department of Transportation, Research and

(Name, Address, Phone, Email)	Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov

Research and Results

Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	Electric vehicles (EVs) obtain at least a part of their energy required for their propulsion from electricity. The market for EVs, including hybrid, plug-in hybrid, and battery electric vehicles continues to grow, as many new and affordable models have become available in recent years. The proliferation of EVs in the vehicle fleet has implications for energy use and emissions. The mobile source (vehicle exhaust) emissions component is of particular relevance to transportation agencies, especially those in nonattainment and attainment maintenance areas that need to meet transportation conformity requirements. This project presents a framework to incorporate EVs into mobile source emissions estimations. The framework uses the United States Environmental Protection Agency's Motor Vehicle Emissions Simulator (MOVES) model. It integrates EV driving characteristics, emissions rates, and market penetration information into a MOVES-based emissions inventory analysis. Vehicle activity data collection and drive schedule development, along with in-use emissions measurements, were conducted for a sample of EVs in Texas. Additionally, market penetration scenarios were developed using a consumer choice model. The collected data and market penetration scenarios were then used in the framework to conduct a pilot application for a large county in Texas. The pilot application demonstrated successful use of the framework and showed that including EVs in emissions analyses can potentially have an impact on the overall analysis results specifically for future years.

Project Information

High Value Research Title	Assessment of the Effectiveness of Wrong Way Driving Countermeasures and Mitigation Methods
Project Number	0-6769
Project Cost	$321,889
Project Duration	23 months
Web link	http://tti.tamu.edu/documents/0-6769-1.pdf

Submitter

Submitter Agency	Texas Department of Transportation
Submitter (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov

Research Program	
Sponsoring Agency Name	Texas Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov

Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	This project evaluated the effectiveness of wrong way driving countermeasures and mitigation methods. Researchers reviewed the state of the practice regarding wrong way driving in the United States and Texas. Based on Texas crash data from 2007 through 2011, the majority of wrong way driving crashes on controlled-access highways occur in major metropolitan areas at night between midnight and 5:00 a.m. Driving under the influence was the primary contributing factor; therefore, the researchers designed and conducted two closed-course studies to determine the effectiveness of select wrong way driving countermeasures on alcohol-impaired drivers. In addition, researchers obtained data from several Texas agencies that had installed wrong way driving countermeasures or mitigation methods on their road network. Using these datasets, researchers assessed the effectiveness of these strategies in actual operational environments. Researchers used the findings from these studies to develop recommendations regarding the implementation of wrong way driving countermeasures and mitigation methods. The researchers used the focus group discussion method to obtain motorists' opinions regarding the design of wrong way driver warning messages. The researchers also reviewed previous literature and message design manuals to gain insight into the design of wrong way driver warning messages that could be posted on dynamic message signs. Based on the findings, researchers developed two single-phase wrong way driver warning messages for dynamic message signs. In addition, radar and illuminated signs warning drivers of wrong way movements were installed on the US 281 corridor and in construction zones. San Antonio has seen a 30 percent reduction in WWD incidents. The number of WWD calls to 911 decreased between 2012 and 2015 from 330 to 280, and TxDOT personnel estimate that 40 lives have been saved due to implementation of wrong way warning devices and monitoring high incident WWD corridors.

Project Information

High Value Research Title	Creep Behavior of Soil Nail Walls in High Plasticity Index (PI) Soils
Project Number	0-6784

Project Cost	$349,640
Project Duration	35 months
Web link	http://tti.tamu.edu/documents/0-6784-1.pdf
Submitter	
Submitter Agency	Texas Department of Transportation
Submitter (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov
Research Program	
Sponsoring Agency Name	Texas Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov
Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	An aspect of particular concern in the Geotechnical Engineering Circular No. 7: Soil Nail Walls (i.e., the soil nail wall manual and construction guidelines) is the creep behavior of soil nail systems in high-plasticity clays. This research project was aimed at gaining a better understanding of the long-term behavior of the soil nail walls in fine-grained soil with plasticity index higher than 20. The project was composed of field, laboratory, and numerical modeling investigations. Pullout tests were performed at the National Geotechnical Experimental Site at Texas A&M University (NGES-TAMU) and at the actual soil nail wall project site selected by the Texas Department of Transportation (TxDOT). The TxDOT site was also instrumented and monitored for more than one year. The tests at the NGES-TAMU were focused on the effect of the load level on creep behavior of soil nails in a natural clay deposit of high plasticity. The tests were conducted on 10 existing anchors, which were installed in 1991, along with 16 vertical soil nails installed in this research project, and six sacrificial soil nails installed during the construction of a TxDOT soil nail wall. This wall corresponds to a new excavation project in an embankment fill, in which nine permanent soils nails were instrumented with the aim of monitoring the long-term behavior and performance of the wall in a high-plasticity clay. Complementary laboratory tests to learn about the creep behavior of the clays involved in this research project were performed at Texas A&M University using samples gathered from the two investigated sites. The numerical modeling had three goals: 1) to calibrate the constitutive models using the information gathered from the laboratory and the pullout tests; 2) to simulate the long-term behavior of the actual soil nail

	wall and compare the model and monitoring results; and 3) to perform a parametric analysis to study the effect of different factors, among others, wall geometry and soil parameters. Based on the information obtained from the project activities, a procedure was proposed to take into account the creep effects in the design of soil nail wall in high-plasticity soils. In addition, the Federal Highway Administration is considering adding these test methods in an update of the Geotechnical Engineering Circular No. 7, thereby increasing the exposure of these test methods to a nationwide level.

Project Information

High Value Research Title	The 2055 Freight Transportation System and the Impact of Near Term Rail Improvements on TxDOT Planning
Project Number	0-6809
Project Cost	$490,343
Project Duration	13 months
Web link	

Submitter

Submitter Agency	Texas Department of Transportation
Submitter (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov

Research Program

Sponsoring Agency Name	Texas Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov

Research and Results

Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	Efficient, reliable, and safe freight transportation is critical to the economic prosperity of any region. An efficient multimodal and intermodal transportation system reduces transportation and supply chain transaction costs and increases connectivity, mobility, reliability, and accessibility to local and global markets. An efficient freight transportation system supports economic development, expansion of international trade, increased employment, growth in personal income, and growth of the gross domestic product of a region, ultimately improving the quality of life of its citizens. This research analyzes major

	trends (i.e., global trade, sociodemographic, environmental, and technology trends) that could impact the future business models of companies in Texas; identifies and discusses factors that influence companies site selection decisions and explores how Texas ranks compared to other states; discusses changing business models and the associated impacts on and expectations for a future freight transportation system; and provides insight into the foreseen role for the Texas Department of Transportation in planning for an efficient, reliable, and safe freight transportation system in 2055 that supports the growth of industry and ultimately the Texas economy. In particular, growing demand for rail transportation both domestically and between Canada, Mexico, and the United States has had large impacts as both imports and exports moving by rail traverse the state heading to ports of entry at Texas-Mexico border crossings and at Texas seaports. Mexican rail companies that serve the Texas-Mexico border have been experiencing high levels of traffic growth in recent years to the point that additional study was needed to quantify the implications of increased rail traffic for short- and long-term transportation planning in Texas. This research explores changes in Texas rail imports/exports, examines recent rail traffic volumes, and assesses potential infrastructure impacts. It also defines potential areas of involvement that TxDOT's Rail Division and Freight and International Trade Office might take to work more closely with Mexican rail stakeholders and private U.S. rail companies to identify the planning efforts and practices that TxDOT must adopt to respond to increased rail traffic throughout the state in order to preserve both rail and highway mobility.

Project Information

High Value Research Title	Effects of New Prestress Loss Predictions on TxDOT Bridges
Project Number	0-6374
Project Cost	$787,521
Project Duration	47 months
Web link	http://library.ctr.utexas.edu/ctr-publications/0-6374-2.pdf
Submitter	
Submitter Agency	Texas Department of Transportation
Submitter (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov
Research Program	

Sponsoring Agency Name	Texas Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov

Research and Results

Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	This project investigated prestress losses in pretensioned concrete girders. The prestress loss estimates in the AASHTO LRFD Bridge Design Specifications had been recalibrated in 2005 to be more accurate for "high-strength [conventional] concrete." Greater accuracy implies less conservatism, the result of which may be flexural cracking of beams under service loads. As a result, this project was developed to provide an experimental evaluation and an engineering recommendation of whether implementation of the new prestress loss estimates currently outlined in AASHTO LRFD 2012 is appropriate for TxDOT. The primary objectives of this project were: (1) to assess the conservatism and accuracy of the current prestress loss provisions, (2) to identify the benefits and weaknesses of using the AASHTO LRFD 2004 and 2012 prestress loss provisions, and (3) to make recommendations to simplify the prestress loss provisions of AASHTO LRFD 2012. These objectives were accomplished through (1) the fabrication, conditioning, and testing of 30 field-representative girders, (2) the assembly and analysis of a prestress loss database, (3) a parametric study of the design implications of the various prestress loss provisions. The database evaluation, coupled with the experimental results, revealed that use of the AASHTO LRFD 2012 prestress loss provisions resulted in an underestimation of the prestress loss in nearly half of all cases. Consequently, new prestress loss provisions were developed through simplification and recalibration of the method outlined in AASHTO LRFD 2012, and prestress loss provisions were found to be simpler, more conservative, and more precise than the current methods outlined within the AASHTO LRFD Bridge Design Specifications. Since these new prestress loss provisions have been adopted, TxDOT has experienced longer bridge deck life spans and shorter bridge construction times, resulting is a savings of approximately $11,200,000.

Project Information

High Value Research Title	Validate Surface Performance-Graded (SPG) Specification for Surface Treatment Binders
Project Number	0-6616
Project Cost	$306,866
Project Duration	23 months

Web link	http://tti.tamu.edu/documents/0-6616-1.pdf
Submitter	
Submitter Agency	Texas Department of Transportation
Submitter (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov
Research Program	
Sponsoring Agency Name	Texas Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov
Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	The design and selection of surface treatment binders in service is currently based on specifications that include tests of emulsion residues or hot-applied asphalt cements at standard temperatures that do not cover the entire range of in-service temperatures, measure properties that are not performance-related, and do not consider representative aging conditions for the critical first year. Current specifications for these binders consider properties of the material during both construction and in service, and a wide range of materials can be utilized to meet the current specified properties. A surface performance-graded (SPG) specification for the evaluation and selection of chip seal binders which addressed these shortcomings was developed as part of previous Texas Department of Transportation (TxDOT) and National Cooperative Highway Research Program (NCHRP) research projects. In the current study, the SPG specification was revised and further validated. This was accomplished by standardizing the emulsion residue recovery method through the evaluation of two warm oven methods, exploring the exclusive use of the dynamic shear rheometer (DSR) for determining performance-related properties, and further field validating the thresholds for these properties. The laboratory and field results were used to revise the SPG specification for surface treatment binders in service. Moreover, the results obtained from the multiple stress creep recovery and DSR frequency sweep tests were compared with field performance to evaluate additional criteria for the specification. The researchers produced a revised SPG specification for performance-related properties that address aggregate retention and bleeding in service. In a two-year period following the end of this project, the revised SPG specification has been implemented in 27 locations statewide. It is estimated that this revised specification will increase service life of a seal coat treatment by an additional year, resulting in

	annual savings to TxDOT of approximately $15,000,000.

Project Information

High Value Research Title	Statewide Implementation of Very Thin Overlays
Project Number	5-5598
Project Cost	$305,000
Project Duration	59 months
Web link	http://tti.tamu.edu/documents/5-5598-03-1.pdf
Submitter	
Submitter Agency	Texas Department of Transportation
Submitter (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov
Research Program	
Sponsoring Agency Name	Texas Department of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	Wade Odell, P.E., Texas Department of Transportation, Research and Technology Implementation Office, 125 E. 11th Street, Austin, TX 78701 (512) 416-4737, wade.odell@txdot.gov
Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	Very thin overlays are defined as overlays where the final lift thickness is 1 inch or less. These are designed to be high performance overlays in that they have to pass both a rutting (Hamburg Wheel tracking Test) and reflection cracking (Overlay Test) requirements. In this study, three different types of thin overlays were designed and placed in the field; these being the open graded (fine Permeable Friction Course), gap graded (fine Stone matrix Asphalt) and fine dense graded mix. To meet the performance requirements, only high quality aggregates were recommended for these mixes, and for most applications the use of a PG 76-22 binder was recommended. Consequently, these mixes cost approximately 30% more per ton than traditional dense graded mixes; however, because of the thin placement temperatures, a substantial savings per square yard has been reported when using these mixes. Test sections using very thin overlays were built throughout the state, and the performance to date has been excellent. Specifications were written, and many of the recommendations have been incorporated into the current statewide construction and maintenance specifications. In 2014, approximately 2,000,000 tons of hot mix asphalt concrete (HMAC) was

	used on Texas highways. In 2015, approximately 635,000 fewer tons of HMAC was used due to use on thin overlay HMAC projects, resulting in approximate annual savings of $50,000,000.

Utah (2)

Project Information	
High Value Research Title	Developing a Utah Bicycle and Pedestrian Counts Guidebook
Project Number	15-8620, UT14.606
Project Cost	$50,000
Project Duration	15 months
Web link	https://www.udot.utah.gov/main/uconowner.gf?n=27583506869578923
Submitter	
Submitter Agency	Utah Department of Transportation
Submitter (Name, Address, Phone, Email)	David Stevens, UDOT Research, P.O. Box 148410, Salt Lake City, UT 84114-8410, ph. 801-589-8340, email davidstevens@utah.gov
Research Program	
Sponsoring Agency Name	Utah Dept. of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	David Stevens, UDOT Research, P.O. Box 148410, Salt Lake City, UT 84114-8410, ph. 801-589-8340, email davidstevens@utah.gov
Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	Over the past five years, non-motorized modes of transportation have become ever more prevalent on Utah's roadways. Historically, these modes have not been included in traffic counts nor are they accurately represented in the long range planning models used by UDOT and the MPOs. This exclusion creates an incomplete picture of both state and local transportation systems, making it difficult to evaluate facility usage. This research created a structured approach for conducting non-motorized user counts, including which methods are most appropriate for conducting bicycle and pedestrian counts across Utah's diverse urban and rural environments. First, existing methods and technologies for counting non-motorized transportation users were identified; Second, methods were evaluated based on their appropriateness and effectiveness in different environments/conditions, and for different purposes (e.g. recreation, transportation, transit access); Third, Radar Signal and Micro Radar technologies were tested locally to identify their feasibility for use

	in counting non-motorized system users. After evaluating all existing count methodologies and testing new potential methods, findings were summarized and compiled into a practical guidebook. The Utah Bicycle and Pedestrian Counts Guidebook systematically walks users through a counts process by outlining necessary steps for creating a counts program, preparing to conduct counts, selecting methods and technologies for any given site, collecting count data, and synthesizing the data in a meaningful way. Recommendations from this work promote local technical innovation including the creation of a statewide online repository and storage site for non-motorized count data, which would serve as a data clearinghouse for planning and analysis. The guidebook is intended to educate local jurisdictions, government agencies, UDOT Region staff, MPOs, advocacy groups, or even members of the public on how to plan, prepare for, and conduct counts of non-motorized system users. The creation of the Utah Bicycle and Pedestrian Counts Guidebook will allow diverse groups across the state to confidently prepare for and conduct counts using standard techniques that promote uniformity and ensure that data no longer goes to waste. Implementation has begun, in that a few agencies in Utah have shown interest in using the new guidebook in their counting efforts. Web link is to the final report (2016), which includes the guidebook. Attachments provided in RPM include: 1) Project article from the Spring 2016 UDOT Research Newsletter, 2) Utah Bicycle and Pedestrian Counts Guidebook, and 3) Project final report from 2016.

Project Information

High Value Research Title	Correlation of Lab and Field Friction Measurements to Optimize Asphalt Aggregates
Project Number	14-8610, UT13.106
Project Cost	$45,000
Project Duration	25 months
Web link	http://www.udot.utah.gov/main/uconowner.gf?n=27619626237695278
Submitter	
Submitter Agency	Utah Department of Transportation
Submitter (Name, Address, Phone, Email)	David Stevens, UDOT Research, P.O. Box 148410, Salt Lake City, UT 84114-8410, ph. 801-589-8340, email davidstevens@utah.gov
Research Program	

Sponsoring Agency Name	Utah Dept. of Transportation
Sponsoring Agency Contact (Name, Address, Phone, Email)	David Stevens, UDOT Research, P.O. Box 148410, Salt Lake City, UT 84114-8410, ph. 801-589-8340, email davidstevens@utah.gov

Research and Results

Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	The basis of the current Utah Department of Transportation specification requirements for polish value of surfacing aggregates is not supported with a statistically adequate correlation. A statistically significant correlation is needed to pre-qualify surfacing aggregates for the anticipated frictional performance and allow optimal utilization of aggregate sources. Adequate pre-qualification of surfacing aggregates and correlation with the pavement frictional performance allows for suitable matching of the friction supplies to the pavement friction demands. The objective of this research is to develop a three-way correlation of measurements between the British Pendulum Tester (BPT) in the field, the BPT in the laboratory, and the lock-wheel skid trailer. Twelve pavement sections scheduled for resurfacing, each older than 8 years, were selected in Salt Lake, Sevier, and Emery Counties consisting of open-graded surface course (OGSC), hot mix asphalt (HMA), and Stone Matrix Asphalt (SMA). Revised AASHTO laboratory polish value procedures were followed in order to reduce the variability inherent in the old procedures. Prior to performing skid testing, the laboratory pendulum was brought to the field for friction tests to correspond with the wheel path of the skid trailer. Given the findings of this study, the researchers recommend that UDOT engineers adopt the revised variability-reducing laboratory friction testing techniques. A statistically significant friction correlation (R-squared value of 0.81) between laboratory and field friction tests was found along with a statistically significant temperature correlation (R-squared value of 0.44), and both are recommended as the basis of the polish value specification revision. Implementing the research findings is anticipated to improve consistency in pre-qualification of surfacing aggregates, as well as overall safety for roadway users. In an effort to implement the research findings of this study, the researchers have proposed to UDOT engineers the following three recommendations: First, based on the strong correlation between laboratory polish value and field friction values, the researchers recommended that this be the basis for a revision to the current pre-qualification specification that requires laboratory polish values to be 31 or higher. The research shows that a skid value of 45 could be obtained with a polish value of 29. In addition, it is recommended that a tiered approach to the polish value specification be consider in order to take into account the trafficking level of the roadway. This research finding could be implemented in the next UDOT specification manual.

	Secondly, based on the correlation between lock-wheeled skid values and temperature, the researchers recommended that the skid trailer be equipped with a pavement temperature monitoring device. The skid data could then be normalized for temperature in addition to speed. Finally, the researchers found that more accurate testing of pavement macro-texture could be accomplished by replacing the ribbed tire with a smooth tire when operating the lock-wheeled skid trailer. The UDOT skid trailer was recently retrofitted and updated with new equipment, including a temperature device. The researchers are helping to come up with equations to normalize pavement temperatures in order to reduce variability. In 2015 there was an opportunity to use the developed correlation equations to help UDOT engineers correlate the BPT skid friction value of a SMA road surface on I-15 to a skid value. This successful case study is documented in the Appendix of the research report. The researchers have also been able to implement the correlation equations to help rewrite the polyester polymer concrete overlay specification to help establish a BPN friction threshold after construction. In addition, the correlation equations have been used to help Arizona DOT on a section of roadway that did not have enough space for a skid trailer but still needed friction testing. Web link is to the final report (2016). Attachments provided in RPM include: 1) Project article from the Summer 2015 UDOT Research Newsletter, 2) Project article from the Winter 2015 Pavement Preservation Journal, and 3) Project final report from 2016.

Washington (3)

Project Information	
High Value Research Title	HeadLight: A Mobile Project Inspection System
Project Number	K780
Project Cost	$400,000
Project Duration	30 months
Web link	http://www.paviasystems.com/solutions/headlight/
Submitter	
Submitter Agency	Washington State Department of Transportation
Submitter (Name, Address, Phone, Email)	Lu Saechao, P.E. Washington State Department of Transportation Research and Library Services P.O. Box 47372 Olympia, WA 98504-7372 360-705-7260 saechal@wsdot.wa.gov

Research Program

No data entered for this section

Research and Results

Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	HeadLight is an easy-to-use mobile project inspection system that is designed to transform current inspection processes, making them more efficient, effective and comprehensive. It allows field personnel to enter project inspection information in the field, generate daily documentation and create an integrated, easy-to-search, information repository so other team members can access information in real-time which allows for quick and easy decision-making right now and effective retrieval later on. The majority of this work was funded by and conducted in Washington, but both Minnesota and Texas DOT's were a part of this project through a pooled fund. A three month pilot was conducted in all three states to gather feedback and measure outcomes. Major takeaways included: (1) Elimination of redundant work: Using HeadLight, inspectors were able to eliminate one hour and forty-five minutes per day of extra work effort. (2) Improved data collection: Inspectors collected 275% more data without incurring any additional hours. (3) Easy to learn: Inspectors reported feeling comfortable using HeadLight in fewer than three days. (4) Improved reporting process: 100% of inspectors preferred submitting reports with HeadLight when compared to the prior process. (5) Data access and quality: Project Engineers reported huge value in having real-time access to field data. They also reported significant improvements in the type of data received. WSDOT is implementing the use of HeadLight in 2015-16 and contemplating opening a new pooled fund to open this project inspection system to other DOT's.

Project Information

High Value Research Title	Evaluation of the Safety Performance of Continuous Mainline Roadway Lighting on Freeway Segments in Washington State
Project Number	T1461-06
Project Cost	$125,000
Project Duration	29 months
Web link	

Submitter	
Submitter Agency	Washington State Department of Transportation
Submitter (Name, Address, Phone, Email)	Doug Brodin PO Box 47372 Olympia, WA 98504-7372 brodind@wsdot.wa.gov

Research Program
No data entered for this section

Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	Roadway lighting is installed with the goal of nighttime crash reduction. Illumination reform at WSDOT is motivated by a desire to optimize tradeoff decisions made during the design and operations of state highways. The ability to assess these tradeoffs has occurred as the science of highway safety has evolved rapidly in recent years, and these quantitative methods allow advances in understanding. The evolution of science based methods and recent findings by several researchers (Milton, Shankar and Mannering 2008, Bullough, Donnell and Rea 2012; Donnel, Porter and Shankar 2010; Gross and Donnell 2011; and Bullough, Donnell and Rea 2013) all indicated a potential for new and enhanced understanding of the safety performance of continuous lighting and subsequently additional efficiency in its asset management and reduced environmental impacts. The 13% growth in illumination systems at WSDOT over 9 years is not sustainable - the annualized life cycle cost of this system is $13.5 million per year and with a current $5 million budget shortfall for annual replacement costs. Prior to the 1980s WSDOT eliminated lighting as part of a lighting reduction program and in the late 1990s continuous lighting were removed from parts of the interstate to reduce energy costs. WSDOT did not observe any adverse impacts on the safety performance of these facilities. From a modeling perspective the presence of these unlit segments are appealing because it creates variation in lighting conditions across similar location characteristics across the system. The research team used a mainline freeway segment dataset with crash data for 2010 through 2014 to estimate random parameter (RP) models with lighting variables such as median continuous, right side continuous, both side continuous, point lighting and no lighting values. It is important to note that the research did not cover point lighting locations but instead only evaluated the performance of continuous mainline illumination on limited access highways. Based on the random parameter modeling of continuous mainline lighting on freeways, the research team concludes that continuous illumination makes no measurable contribution to nighttime safety performance. Also, that the installation of continuous mainline lighting

	on freeways for safety performance is not warranted. Further, findings from the pilot LED project on US101 (Black Lake Blvd) indicate that LED roadway lighting can significantly increase energy efficiency, reduce greenhouse gas emissions and that the general public experienced the LED project as positive. Leading to the conclusion that illumination reform is a reasonable and practical way to improve the sustainability of the system while maintaining environmental stewardship. The research team recommends that WSDOT discontinue installation of continuous mainline lighting on freeways as a required design element, and where appropriate consider illumination removal. If funding is available and lighting reform remains a priority continue evaluation of illumination safety performance on the remainder of the highway system.

Project Information

High Value Research Title	DRIVE Net: Online Moving Washington Platform for Network-Wide System Operations, Monitoring, and Analysis
Project Number	T1461-05
Project Cost	$520,000
Project Duration	56 months
Web link	http://www.uwdrive.net/about.html

Submitter

Submitter Agency	Washington State Department of Transportation
Submitter (Name, Address, Phone, Email)	Doug Brodin PO Box 47372 Olympia, WA 98504-7372 brodind@wsdot.wa.gov

Research Program

No data entered for this section

Research and Results

Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	The goal of this research was to remove the barriers in the current datasets archived by WSDOT, automate the time-consuming data quality control process, and achieve the integration and visualization of information necessary to support decision making. The research findings describe the data fusion techniques and database design details and are delivered in a functioning online system named WSDOT Digital Roadway Interactive Visualization and Evaluation Network (DRIVE Net). This WSDOT DRIVE Net system is capable of collecting,

	archiving, and quality checking traffic sensor data from all WSDOT regions. It has also been built to incorporate third party data, including freeway loop data, INRIX GPS, Washington Incident Tracking System (WITS), and weather data, into well-designed databases. Unlike other prevailing transportation data archiving systems, DRIVE Net is also capable of processing and storing massive amounts of spatial data by using open-sourced spatial database tools. This significantly alleviates the computational and financial burden of using commercial geographic information system (GIS) software packages and grants maximum flexibility to end users. By properly combining both traditional transportation and spatial data, a more robust GIS-T model is available for large-scale modeling and network-level performance measures following eScience principles. The DRIVE Net is built for a region-wide web-based transportation decision support system that adopts digital roadway maps as the base, and provides data layers for integrating a variety of data sources (e.g., traffic sensor and incident). Moreover, DRIVE Net offers a platform for optimizing transportation analysis and decision making, and serves as a practical tool for visualizing historical observations spatially and temporally. Not only can DRIVE Net be used for a variety of transportation analyses, but with the use of its online computation engine, DRIVE Net can also help evaluate the benefit of a specific transportation solution. In its current implementation, DRIVE Net demonstrates the potential to be used as a standard tool to incorporate more data sets from different fields and provides a platform for real-time decision making. In summary, this research sheds light on the development of an eScience transportation platform and provides an interoperable data-driven online tool to substitute for WSDOT's existing data systems.

Wyoming (3)

Project Information	
High Value Research Title	Implementation and Local Calibration of the MEPDG Transfer Functions in Wyoming
Project Number	RS03209 - FHWA-WY-1602F
Project Cost	$404,972
Project Duration	80 months
Web link	http://ntl.bts.gov/lib/56000/56600/56658/RS03209_FHWA1602F_MEPDG.pdf
Submitter	
Submitter Agency	Wyoming Department of Transportation
Submitter (Name, Address, Phone,	Tim McDowell

Email)	
Research Program	
Sponsoring Agency Name	FHWA WYDOT
Sponsoring Agency Contact (Name, Address, Phone, Email)	Tim McDowell, Wyoming Department of Transportation, 5300 Bishop Blvd., Cheyenne, WY 82001, tim.mcdowell@wyo.gov, 3077774177
Research and Results	
Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	The Wyoming Department of Transportation (WYDOT) used the empirical AASHTO Design for Design of Pavement Structures as their standard pavement design procedure. WYDOT planned to transition to the Mechanistic Empirical Pavement Design Guide (MEPDG) for designing new and rehabilitated highway pavements. As a part of the transitioning process, WYDOT sponsored a two part implementation project. One part was to verify or confirm that the MEPDG transfer functions and global calibration coefficients derived from NCHRP project 1-40D reasonably predict distresses and smoothness in Wyoming. The Wyoming Long-Term Pavement Performance (LTPP) and non-LTPP roadway segments, as well as LTPP test section in adjacent states were used for this verification-calibration process. One of the tasks within this project focused on using the Wyoming LTPP test sections to confirm the applicability of the global calibration coefficients. Results from the initial verification concluded some of the transfer functions exhibited significant bias between the measured and predicted distress and require local calibration. Thus, some of the LTPP test sections in adjacent states with similar design features built in Wyoming combined with some non-LTPP roadway segments in Wyoming were used to determine the coefficients of the transfer functions to eliminate any bias between the measured and predicted distresses. The report documented the local calibration of the transfer functions using LTPP and non-LTPP roadway segments. The calibration process followed the steps presented in the 2010 AASHTO MEPDG Local Calibration Guide. Local calibration coefficients were derived to remove that bias for the rutting, fatigue cracking, and thermal cracking transfer functions of flexible pavements, and the faulting and fatigue cracking transfer functions of rigid pavements. The global coefficients of the smoothness degradation regression equation for flexible and rigid pavements were also checked for their applicability to Wyoming conditions. As a result of the research study, WYDOT has converted its pavement design approach from the older DARWin 3.1 to the newer mechanistic empirical pavement design. As part of this conversion, WYDOT has purchased the AASHTOWare Pavement ME Design software. Included in the research outcomes are the modifications to the way WYDOT collects and reports traffic data. This data is one of the input parameters of the software. As a follow up to this study, WYDOT is currently

	conducting a study to further refine the design software by calibrating for local materials.

Project Information

High Value Research Title	Pronghorn and Mule Deer Use of Underpasses and Overpasses Along US Highway 191, Wyoming
Project Number	RS11211 - FHWA - WY-16/01F
Project Cost	$139,883
Project Duration	49 months
Web link	http://ntl.bts.gov/lib/56000/56900/56922/RS11211_1601F.pdf

Submitter

Submitter Agency	Wyoming Department of Transportation
Submitter (Name, Address, Phone, Email)	Tim McDowell

Research Program

Sponsoring Agency Name	FHWA WYDOT
Sponsoring Agency Contact (Name, Address, Phone, Email)	Tim McDowell, Wyoming Department of Transportation, 5300 Bishop Blvd., Cheyenne, WY 82001, tim.mcdowell@wyo.gov, 3077774177

Research and Results

Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	The seasonal migrations of ungulates are increasingly threatened by various forms of anthropogenic disturbance, including roads, fences, and other infrastructure. While roadway impacts (i.e., wildlife?vehicle collisions and landscape permeability) of two?lane highways to mule deer (Odocoileus hemionus) can largely be mitigated with underpasses and continuous fencing, similar mitigation may not be effective for pronghorn (Antilocapra americana) or other ungulate species that are reluctant to move through confined areas. The Wyoming Department of Transportation recently installed 6 underpasses and 2 overpasses along 20 km of US Highway 191 in western Wyoming, where we evaluated species?specific preferences by documenting the number of migratory mule deer and pronghorn that used adjacent overpass and underpasses for 3 years following construction. We also measured the amount of back and forth movement across the highway for each species through time. We documented 40,251 mule deer and 19,290 pronghorn migrate across the highway. Of those, 79% of mule deer moved under, whereas 93% of pronghorn moved over the highway. These strong

	species?specific differences were evident at both sites and support the notion that overpasses are more amenable to pronghorn than underpasses. Concurrently, we documented a sharp increase in the amount of back and forth movement of mule deer and pronghorn across the highway during migration periods. Such movement flexibility is presumed to improve their ability to respond to changing environmental conditions by easily accessing habitats on either side of the highway. Our results highlight that species?specific preferences are an important consideration when mitigating roadway impacts with wildlife crossing structures. This project showed that overpass and underpass construction reduced wildlife?vehicle collisions by approximately 81%. Continuous fencing used in conjunction with underpasses and overpasses effectively mitigate roadway impacts (i.e., habitat fragmentation, wildlife-vehicle collisions) to migratory mule deer and pronghorn. From the study it was found that WVCs involving pronghorn were completed eliminated, while those involving mule deer were reduced by 79 percent. Reducing WVCs further will require careful maintenance of fence infrastructure (e.g., cattle guards and gates), especially during periods of peak mule deer movement. It was noted that an investment in overpass construction appears warranted in regions that support pronghorn, but may not be necessary in areas inhabited only by mule deer.

Project Information

High Value Research Title	Effects of Wildlife Warning Reflectors (“Deer Delineators”) on Wildlife-Vehicle Collisions in Central Wyoming
Project Number	RS05212 - FHWA - WY - 15/03F
Project Cost	$234,303
Project Duration	34 months
Web link	Link to report
Submitter	
Submitter Agency	Wyoming Department of Transportation
Submitter (Name, Address, Phone, Email)	Tim McDowell
Research Program	
Sponsoring Agency Name	FHWA WYDOT
Sponsoring Agency Contact (Name, Address, Phone, Email)	Tim McDowell, Wyoming Department of Transportation, 5300 Bishop Blvd., Cheyenne, WY 82001, tim.mcdowell@wyo.gov, 3077774177

Research and Results

Brief Summary of the Research Project and Impact, or Potential Impact, of Implementing Research Results	The purpose of this study was to provide the Wyoming Department of Transportation with information about (1) the effectiveness of Streiter-Lite wildlife warning reflectors that had been installed in three locations within Wyoming's District 5, and (2) preliminary analysis of patterns of deer-vehicle collisions across Wyoming and the habitat and road variables associated with collision hotspots. We evaluated reflector effectiveness in terms of their ability to reduce deer-vehicle collisions and modify deer road-crossing behavior. Using a series of experimental manipulations of reflectors, we showed that reflectors reduced deer-vehicle collisions by 32 percent and significantly reduced the number of high-risk deer road crossings (those in which deer ran into the road as a car was approaching). However, covering reflectors with white canvas bags – initially done with the intent of creating a control treatment that neutralized the reflectors – proved even more effective than leaving the reflectors exposed. White bags on posts resulted in 33 percent fewer collisions than when reflectors were exposed and significantly reduced the number of high-risk deer road crossings. It is likely that the white bags are more visible or reflective to deer than the red wildlife warning reflectors. A cost-benefit analysis suggests that the benefits of reflectors outweigh their initial materials and installation costs, but may not outweigh the net costs once maintenance is taken into account. Analysis of patterns of deer-vehicle collisions across the state showed that traffic volume, proximity to agricultural land, proximity to deer winter range and migration routes, and high speed limits are all strongly associated with high collision rates. On average, areas with a 55 mph speed limit have 36 percent and 55 percent fewer deer-vehicle collisions than areas with speed limits of 65 and 75 mph, respectively. Reducing nighttime speed limits in high collision areas may be a cost-effective strategy for mitigating deer-vehicle collisions in Wyoming.